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Development of nanoporous TiO_2 and SiC membranes for membrane filtration

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Reverse osmosis membranes are increasingly used for the production of drinking water (desalination of sea water or brackish water), for demineralisation of water in industrial processes (boiled feed water, microelectronics production) as well as in food processing and pharmaceutical production. Today´s reverse osmosis membranes are made of polymers; however, these membranes have several technical limitations, for example, low water fluxes and high sensitivity to oxidizing chemicals. Since membrane fouling is still a major problem in reverse osmosis desalination plants, replacement of polymer reverse osmosis membranes by ceramic counterparts would provide higher fluxes and allow more efficient cleaning of the membranes.

The aim of this work was to prepare defect-free nanoporous ceramic (TiO_2 and SiC) layers on macroporous SiC supports by using electrophoretic deposition and dip-coating. Ceramic powder was dispersed in water and in ethanol, and to increase absolute value of zeta-potential of the particles, different deflocculants (hexadecyltrimethylammonium bromide, polyethylene imine) were added. In parallel, SiC layers were prepared by dip-coating of suspensions containing pre-ceramic polymer allyl-hydridopolycarbosilane dissolved in hexane with addition of submicron SiC particles. In all the cases, after coating step, the layers were dried and heat treated under different conditions. Results show that particle size distribution and thickness of the coatings play an important role in formation of defects. The number of defects decreased with decreasing thickness of the coatings. Furthermore, coatings composed of a mixture of nanosized and submicron SiC powder were more homogeneous than the coatings composed only of nanosized SiC powders. In comparison to conventionally sintered SiC coatings, polymer derived SiC coatings were much better adhered to the surface of macroporous SiC supports.